1 Understanding the relationship between macroeconomic conditions and health

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1. Macroeconomic Conditions, Health and Mortality

Health is conventionally believed to deteriorate during macroeconomic downturns. However, the empirical evidence supporting this view is surprisingly weak and research conducted over the last decade instead suggests that mortality *decreases* and physical health *improves* when the economy temporarily weakens. This partially reflects reductions in external sources of death, such as traffic fatalities and other accidents, but changes in lifestyles and health behaviours also play a role. This chapter summarizes how recent research has changed our current understanding of how health is affected by macroeconomic fluctuations.

2. Time Series Analyses for Single Locations

The relationship between macroeconomic conditions and health has been extensively examined using time series data for a single geographic location, such as the United States. Most influential have been the studies by M. Harvey Brenner (for example, Brenner, 1971, 1979) arguing that recessions and other sources of economic instability increase overall mortality, infant deaths, and fatalities from cardiovascular disease, cirrhosis, suicide, and homicide as well as morbidities, alcoholism and admissions to mental hospitals.

However, many researchers (for example, Kasl, 1979; Gravelle et al., 1981; Stern, 1983) point out serious flaws in Brenner's analysis and, in studies correcting these problems (for example, McAvinchey, 1988; Joyce and Mocan, 1993), the results are sensitive to the choice of countries, time periods and proxies for health. With the exception of Brenner's research, most time series evidence suggests that the contemporaneous effect of economic downturns is to improve health and reduce mortality. Analyses undertaken as early as the 1920s by Ogburn and Thomas (1922) and Thomas (1927) identify a positive correlation between macroeconomic activity, total mortality and deaths from several specific causes (with the exception of suicides); Eyer (1977) obtains a similar finding using US data from 1870–1975. These correlations, while not conclusive, hint at a *pro-cyclical* variation in mortality.

Recent time series analyses correct for some problems inherent in earlier studies. McAvinchey (1988), for instance, uses statistical rather than ad-hoc methods to choose the lag length and order of the polynomial lag; Joyce and Mocan (1993) and Laporte (2004) correct for non-stationarity in the time series data; Gerdtham and Johannesson (2005) use multiple business cycle indicators with data on individual, rather than aggregate, mortality risk; Tapia Granados and Ionides (2008) implement spectral analysis techniques. Despite these innovations, the results remain ambiguous. Most of this research continues to suggest that mortality is pro-cyclical (for example, Laporte,

2004; Tapia Granados, 2005a) but some finds counter-cyclical effects (Gerdtham and Johannesson, 2005), no impact (Joyce and Mocan, 1993) or variation across countries or time periods (McAvinchey, 1988; Tapia Granados and Ionides, 2008).

Such a lack of robustness should not be surprising since any lengthy time series may yield biased estimates due to omitted variables that are spuriously correlated with economic conditions and affect health.[1] This problem has long been recognized by at least some researchers. A solution proposed by Kasl (1979, p. 787) is to take 'advantage of local and regional variations in the business cycle as well as in disease rates'. Stern (1983, p. 69) similarly points to the promise of using differencing techniques with panel data. Research using these strategies has become increasingly common in the last decade and is the focus of the remainder of this chapter.

3. Estimates using Pooled Data with Location-Specific Fixed Effects

Many recent studies address the omitted variables bias issue by estimating models using panel data for multiple locations at several points in time. Some analyses (including most examining mortality) use geographically aggregated variables; others (such as those focusing on morbidities or lifestyles) typically utilize individual data but with the key macroeconomic determinants measured over larger areas.

Studies based on aggregate data usually estimate some variant of:

$$Y_{jt} = \alpha_j + X_{jt}\beta + E_{jt}\gamma + \lambda_t + \varepsilon_{jt}, \tag{1.1}$$

where Y_{jt} is a health outcome or input in location j at time t, E measures macroeconomic conditions, X is a vector of covariates, α is a location-specific fixed effect, λ a general time effect, and ε is the regression error term. The corresponding equation with microdata is:

$$Y_{ijt} = \alpha_j + X_{ijt}\beta + E_{jt}\gamma + \lambda_t + \varepsilon_{ijt}, \tag{1.2}$$

where i indexes the individual.

Unemployment rates are the most common primary proxy for macroeconomic conditions but other variables (for example employment-to-population ratios or per capita GDP) are sometimes used. Interpretation of the results in models that also control for incomes is more complicated since permanent growth may improve health but transitory improvements in the economy need not. Moreover, since incomes fall during temporary downturns, their inclusion is likely to absorb and possibly explain a portion of the macroeconomic effect. Supplementary regressors vary but often include measures of age, education and race/ethnicity. Some analyses add lags of the macroeconomic variables or use other methods to capture dynamics of the adjustment process.

To illustrate the econometric strategy, consider annual mortality rates for a panel of states estimated using equation (1.1). The year effects (λ_t) hold constant determinants of death that vary uniformly across states over time, the fixed-effects (α_j) account for those that differ across locations but are time-invariant, and the impact of the macroeconomy is identified from within-state variations relative to the changes in other states. The state and year effects control for a wide variety of determinants of health – such as lifestyle differences between residents of Nevada and Utah or advances in widely used medical technologies. The model does *not* account for unobserved factors varying within states

over time, but inclusion of a vector of state-specific time trends often substantially rectifies this.[2]

Although unemployment rates are often used to *proxy* macroeconomic conditions, the macroeconomic effects need not be restricted to those changing employment status. For instance, the stress of job loss could have a negative impact on health that is more than offset by improvements for workers whose hours or job-related pressures are reduced.[3]

Adult mortality

Death rates are the most common dependent variables in research using the methods just described. Mortality is useful to study because it represents the most severe negative health outcome, is objective and well measured, and diagnosis generally does not depend on access to the medical system (in contrast to many morbidities). Table 1.1 documents the widespread evidence of a pro-cyclical fluctuation in total mortality and some specific sources of death, obtained in research using disparate samples and time periods, and with some variation in model specifications.

A one-percentage point increase in the unemployment rate is typically associated with a 0.3 to 0.5 per cent reduction in total mortality, corresponding to an elasticity of –.02 to –.05 (Ruhm, 2000; Johansson, 2004; Tapia Granados, 2005b; Gerdtham and Ruhm, 2006). Using German data, Neumayer (2004) estimates a significantly larger decrease, as do Buchmueller et al. (2007) for France.[4] Some reasons why mortality falls are obvious. Individuals drive fewer miles and so motor vehicle fatalities decrease: a one point increase in unemployment is predicted to reduce traffic deaths by between one and three per cent (Ruhm, 2000; Neumayer; 2004; Tapia Granados, 2005b; Gerdtham and Ruhm, 2006; Buchmueller et al., 2007; Lin, 2009; Miller et al., 2009). Other sources of accidental deaths probably decrease as well.

The results are more mixed for deaths from specific medical conditions. Cardiovascular fatalities are pro-cyclical, with variations of similar or larger magnitude (in percentage terms) than for total mortality (Ruhm, 2000; Neumayer, 2004; Gerdtham and Ruhm 2006; Buchmueller et al., 2007; Miller et al., 2009). Particularly strong fluctuations are observed for deaths due to coronary heart disease (Ruhm, 2007), which are likely to be responsive to short-term changes in modifiable health behaviours and environmental risk factors. A pro-cyclical variation in influenza/pneumonia fatalities is also generally obtained. Conversely, cancer mortality is not related to the macroeconomy in most studies (Buchmueller et al., 2007 is an exception), which makes sense since a large short-run impact of even substantial changes in behaviour seems unlikely for this cause of death. Fatalities from most other sources increase when the economy improves but with less consistency across studies. For instance, a pro-cyclical variation in deaths from liver disease is obtained by Ruhm (2000) and Gerdtham and Ruhm (2006) but not by Neumayer (2004) or Buchmueller et al. (2007).

Diverse findings are obtained for suicides. Ruhm (2000) and Miller et al. (2009) uncover a strong counter-cyclical variation, but with weaker effects by Gerdtham and Ruhm (2006), Tapia Granados (2005b), or Lin (2009) and a pro-cyclical pattern obtained by Neumayer (2004) and Buchmueller et al. (2007). There is a similar variation for homicides, pointing to possible differences in the macroeconomic determinants across countries or institutional arrangements. This is particularly salient given evidence

Table 1.1 Macroeconomic effects on mortality estimated using pooled data with location-specific fixed effects

Study	Sample	Major Findings	Comments
Ruhm (2000)	50 states and DC, 1972–91	*Significant Unemployment Effects* ALL: -0.5% [-.04]; 20–44 year olds: -2.0% [-.14]; 65+ year olds: -0.3% [-.02]; CVD: -0.5% [-.03]; FLU: -0.7% [-.05]; VEHICLE: -3.0% [-.21]; EXTERNAL: -1.7% [-.11]; suicide: 1.3% [.09]; homicide: -1.9% [-.13]; INFANT: -0.6% [-.04]; NEONATAL: -0.6% [-.04]. *Insignificant Effects* 45–64 year olds: 0.0%; CANCER: 0.0%; LIVER: -0.4%.	Models control for age structure, race/ethnicity, education, and marital status groups.
Johansson (2004)	23 OECD countries, 1960–97	*Significant Unemployment Effects* ALL: -0.4%; -0.3% for observations with information on work hours. Total mortality is negatively associated with per capita incomes and work hours.	Same sample and specification as Gerdtham and Ruhm (2006), except for addition of work hours in some models.
Neumayer (2004)	16 German states, 1980–2000	*Significant Unemployment Effects* ALL: -1.1%; females: -1.3%; males: -0.9%; 20–45 year olds: -1.1%; 65+ year olds: -1.2%; CVD: -1.8%; FLU: -3.1%; VEHICLE: -1.3%; suicide: -1.4%. *Insignificant Effects* 45–64 year olds: -0.5%; CANCER: -0.1%; LIVER: 0.4%; homicide: 0.3%; EXTERNAL: 1.7%; INFANT: 0.2%; NEONATAL: -1.9%.	Most specifications correspond to Ruhm (2000). Standard errors corrected for heteroscedasticity and autocorrelation. Models control for personal income, age and percent foreign.
Tapia Granados (2005b)	50 Spanish provinces, 1980–97	*Significant Unemployment Effects* All: -0.3% [-.06]; females: -0.3% [-.04]; males: -0.2% [-.06]; CANCER: -0.1% [-.02]; infectious disease: -0.7% [-.14]; VEHICLE: -2.0% [-.38]. *Insignificant Effects* CVD: -0.1%; suicide: 0.5%; homicide: -0.3%.	Models control for age structure and per capita GDP. Similar results obtained using EP ratio as macroeconomic proxy.
Gerdtham and Ruhm (2006)	23 OECD countries, 1960–97	*Significant Unemployment Effects* ALL: -0.4% [-.02]; CVD: -0.4% [-.02]; LIVER: -1.8% [-0.10];VEHICLE: -2.1% [-.12]; EXTERNAL: -0.8% [-.04]. *Insignificant Effects* CANCER: 0.1%; FLU: -1.1% [-.05]; suicide: 0.4%; homicide: 1.1%; INFANT: -0.2%.	Models control for age structure, percent male and country-specific time trends. Stronger effects for large countries and more recent years.

Buchmueller, et al. (2007)	96 French départements, 1982–2002	*Significant Unemployment Effects* All: -0.8% [-.08]; CVD: -1.0% [-.11]; CANCER: -1.1% [-.11]; VEHICLE: -2.0% [-.21]; non-vehicle accidents: -2.5% [-.26]. *Insignificant Effects* LIVER: 0.3%; suicide: -0.5%; homicide: -0.6%.	Models control for age structure. Stronger effects in smaller areas, later time periods (when labour markets became more flexible).
Ruhm (2007)	50 states and DC, 1979–98	*Significant Unemployment Effects* CVD: -0.2% [-.02]; ISCHEMIC: -0.7% [-.05]; AMI: -1.0% [-.07]; non-ISCHEMIC CVD: 0.5% [.03].	Macroeconomic effects similar across sex.
Economou et al. (2008)	13 EU countries, 1977–96	*Significant Unemployment Effects* 25–34 year olds: -0.8% [.07]; INFANT: 0.9% [.08]; CANCER: 0.2% [.02]. *Insignificant Effects* ALL: -0.0%; Males: -0.1%; females: -0.2%, 35–44 year olds: -0.1%; 35–84 year olds: < 0.1%; ISCHEMIC; 0.4%; CANCER: -0.0%; VEHICLE: -0.5%; homicide: 0.2%; suicide: 0.4%.	Unemployment rates not standardized. Models estimated assume that changes in unemployment have a constant effect on the number of deaths, rather than on mortality rates.
Lin (2009)	8 Asian nations, 1976–2003	*Significant Unemployment Effects* Total mortality: -1.4% [-.05]; CVD: -0.9% [-.03]; VEHICLE: -3.4% [-.13]. *Insignificant Effects* INFANT: -0.6% [.08]; suicide: 0.6%.	Models control for age structure, percent male and urban, number of physicians and hospital beds, country-specific time trends.
Miller et al. (2009)	50 states and DC, 1978–2004	*Unemployment Effects* ALL: -0.5%; CVD: -0.5%; infections: -2.0%; kidney: -1.5% [-.05]; VEHICLE: -2.9%; EXTERNAL: -1.0%, homicide: -1.6%; CANCER; 0.2%; suicide: 1.7%. *Age-Specific*: INFANT: -1.5%; 1–17: -1.0%; 18–24; -1.7%; 25–34: -0.8%; 35–54: <0.1%; 55–79; -0.2%; 80–84: -0.7%; 85+: -0.9%	Statistical significance not listed. Models control for state-time trends and same covariates as Ruhm (2000).

Notes: Abbreviations: ALL – total mortality; CVD – cardiovascular disease; ISCHEMIC – ischemic heart disease; AMI – acute myocardial infarction; CANCER – malignant neoplasms; FLU – pneumonia and influenza; LIVER – chronic liver disease; VEHICLE – motor vehicle; EXTERNAL – external causes/accidents other than from motor vehicles; INFANT – infant deaths (in first year); NEONATAL – neonatal deaths (in first 28 days); EP ratio – employment-to-population ratio. Unemployment effects indicate impact of a one percentage point increase; GDP effects show impact of a 1000 peso decrease per capita; elasticities are in brackets. All models control for location-specific effects and general time effects. Significant effects refer to rejection of the null hypothesis at 0.05 level.

by Gerdtham and Ruhm (2006) showing relatively weak procyclical fluctuations in mortality for countries with strong social safety nets.[5]

Infant mortality in the United States also declines when the economy weakens. Ruhm (2000) estimates that a one point rise in unemployment decreases infant and neonatal death rates by 0.6 per cent; Dehejia and Lleras-Muney (2004) predict 0.5, 0.3 and 0.9 per cent reductions in infant, neonatal and postneonatal mortality; and Miller et al. (2009) obtain even stronger pro-cyclical variations. Conversely, no relationship is uncovered for Germany by Neumayer (2004) or OECD countries by Gerdtham and Ruhm (2006), again suggesting variation across institutional environments.

Due to severe data restrictions, few analyses examine how macroeconomic conditions affect morbidity. Ruhm (2003) estimates that a one point increase in unemployment reduces the fraction of adults (30 and over) with one or more medical conditions by 1.5 per cent, which largely reflects a 3.9 per cent decrease in the prevalence of acute problems. The probability of restricted-activity and bed-days (during a two-week period) similarly falls by 1.2 and 1.6 per cent. Finally, 4.3 and 8.7 per cent reductions in the predicted prevalence of ischemic heart disease and intervertebral disk problems contrast with a 7.2 per cent increase in non-psychotic mental disorders. Consistent with this last result, Charles and DeCicca (2008) uncover a pro-cyclical variation in mental health for less educated and African-American males. Combined with the previously discussed results for suicides, these findings suggest that mental and physical health may respond to macroeconomic conditions quite differently.

Health behaviours and medical care

One reason individuals become healthier during economic downturns is because of changes in behaviours and lifestyles. Alcohol use has been most widely studied. Drinking and alcohol-involved vehicle mortality vary pro-cyclically (for example, Evans and Graham, 1988; Ruhm, 1995), with evidence from individual-level data suggesting that the reductions during bad times are dominated by a decline in heavy use (Ruhm and Black, 2002), rather than light drinking which is sometimes linked to health benefits (Thun et al., 1997). Ettner (1997) similarly concludes that alcohol use and dependence are pro-cyclical, while Dee (2001) obtains the contradictory result that economic downturns reduce overall and heavy drinking but increase binge alcohol use, and Johansson et al. (2006) indicate a counter-cyclical pattern of alcohol-related mortality in Finland.

The healthier lifestyles are not restricted to decreases in problem drinking. Ruhm (2005) finds that severe obesity, smoking and physical inactivity decline, with larger (percentage) reductions in multiple risk factors. Further evidence of a pro-cyclical variation in smoking is provided by Gruber and Frakes (2006) and Xu and Kaestner (2010). Ruhm (2000) shows that the consumption of dietary fat falls while the intake of fruits and vegetables rises. Dehejia and Lleras-Muney (2004) indicate that pregnant mothers consume less alcohol, with mixed effects for smoking. However, Böckerman et al. (2006) sometimes obtain a counter-cyclical variation in obesity for Finnish adults (with no relationship in other models), as do Charles and DeCicca (2008) for African-American men and US males with low *ex ante* employment probabilities.

The improvements in health occur despite reductions in the use of most types of medical care: the frequency of routine check-ups, screening tests, doctor visits and hospital episodes all fall during downturns (Ruhm, 2000, 2003). However, pregnant women

obtain earlier and more extensive prenatal care during such periods (Dehejia and Lleras-Muney, 2004), the use of advance treatments for heart disease also increases (Ruhm, 2007), and Xu and Kaestner (2010) uncover a negative relationship between work hours and doctor visits.

Income effects and dynamics

Worse health during *temporary* expansions need not imply negative effects of *permanent* economic progress since transitory increases in output require more intensive use of labour and health inputs with existing technologies, whereas permanent growth, results from technological innovations or expansions in the capital stock that potentially ameliorate any costs to health. Individuals are also more likely to defer health investments in response to a temporary rather than a lasting rise in work hours. Therefore, it comes as no surprise that there is evidence of sharp differences in the effects of temporary and permanent income changes (for example, Graham et al., 1992).

Mixed and inconsistent results are obtained when income is included as an additional covariate in the research using the specifications focused on in this chapter. Income is sometimes positively and other times negatively correlated with mortality and risky behaviours while a fairly uniform protective effect is obtained for morbidities and functional limitations. There is strong evidence that permanent income growth improves health in developing countries, but also some evidence that temporary income growth is associated with higher mortality in middle-income nations such as Colombia or Mexico (Miller and Urdinola, 2010; Gonzales and Quast, 2011).

Studies examining dynamics of the adjustment to fluctuations in the macroeconomy generally suggest that the impact of sustained changes accumulates for a period of time – at least one or two years – with subsequent attenuation observed in some studies but not others. Such findings accord with models of health capital, where investment flows gradually affect the stock of health, leading to effects that increase over time. Additional research is needed to identify the period before a lasting improvement in economic conditions yields health benefits, since this will help to clarify the distinction between effects of temporary and permanent changes that is central to the discussion in this chapter.

4. Why does Health Worsen When the Economy Temporarily Improves?

As mentioned, health could be counter-cyclical because it is an input into short-run increases in the production of goods and services. Moreover, hazardous working conditions, the physical exertion of employment and job-related stress could have negative effects, particularly when job hours are extended during economic expansions (Baker, 1985; Sokejima and Kagamimori, 1998; Kivimäki et al., 2002). Extra work also reduces sleep (Biddle and Hamermesh, 1990) which is linked to increased stress, decreased alertness, greater injury risk, and higher rates of obesity and physiological or psychological symptoms (Sparks and Cooper, 1997). Cyclically sensitive sectors, such as construction and manufacturing, have high accident rates which may be exacerbated, when the economy temporarily improves, by increased hiring of inexperienced workers and speed-ups in production.

Some joint products of economic activity, such as pollution, miles driven and traffic congestion, also present health risks. These negative consequences may be particularly pronounced for vulnerable sectors of the population – such as infants or senior citizens

– who do not participate in the labour force. Economic expansions also induce migration, which could lead to increased social isolation and loss of community support, particularly among the old and young.

Decreases in non-market 'leisure' time make it more costly for individuals to undertake health-producing activities such as exercise and cooking meals at home. Evidence that higher time prices correlate with increased obesity has been provided for adults (Courtemanche, 2009) and children (Anderson et al., 2003). Xu and Kaestner (2010) show that longer work hours are linked to increases in smoking and reductions in physical activity; Edwards (2008) finds that individuals spend less time socializing and caring for relatives when the economy is strong. That said, the direct evidence linking work hours to health outcomes is mixed.

5. Concluding Thoughts

Empirical research conducted over the last decade suggests that physical health improves and mortality declines when the economy temporarily weakens. Some of this is due to decreased driving, with a consequent fall in traffic fatalities, and reductions in other environmental risks, like pollution. Mechanisms for decreased morbidity and deaths from medical conditions such as cardiovascular disease are less well understood. To some extent, this may result from the adoption of healthier lifestyles (for example, decreased smoking, drinking and physical inactivity) but the roles of time availability, income and other factors need to be further explored.

Future research could fruitfully provide further information on whether macroeconomic conditions differentially affect physical and mental health, more fully distinguish between the effects of transitory and permanent growth, and investigate the extent to which the results differ across institutional environments and levels of development. Additional study should also seek to examine the sensitivity of the results to the use of alternative macroeconomic proxies, the extent and nature of the lifestyle changes that accompany macroeconomic fluctuations, and the impact of difficult to measure variables such as stress and social isolation.

Notes

1. For example, the variation in unemployment occurring during the four decades (beginning in the 1930s) covered by much of Brenner's research is dominated by dramatic reductions in joblessness following the great depression, a period where mortality declined due to improved nutrition and increased availability of antibiotics. Methods of testing for potential omitted variables bias when using time series data include examining whether the model estimates are structurally stable over time (Gravelle et al., 1981) and controlling for future values of the macroeconomic variables as an informal test of reverse causality (Joyce and Mocan, 1993).
2. The impact of national business cycles, which could differ from more localized fluctuations, is absorbed by the time effects. Discussions of 'cyclical' variations or 'macroeconomic' effects therefore refer to changes within locations rather than at the national level and terms like 'recessions' are used loosely to indicate deterioration in local conditions, rather than reflecting official technical definitions.
3. The non-employed are in worse average health than workers; however, since poor health reduces employment probabilities, the direction of causation is not well understood.
4. Economou, et al.'s (2008) evidence of a counter-cyclical variation in many sources of mortality is questionable because they do not use standardized measures of unemployment and since some of their models control for smoking, drinking, caloric intake, hospitalization and pollution levels, that are directly affected by macroeconomic conditions and so provide potential mechanisms for the fluctuations in health.
5. Using related analytical methods, Stuckler et al. (2009) find that higher growth of unemployment is associated with increases in suicides and homicides but decreases in traffic deaths.

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